Observations, experimental and otherwise, lead to the belief that where unaided repair results, nature effects this in some of the following ways: (*a*) Closure of the perforation by an adhesion to a neighboring coil. (*b*) An omental adhesion. (*c*) By an adhesion to the abdominal wall. (*d*) Only where the opening is minute by an exudate of plastic lymph. In the experiments terminating in recovery, subsequent examination showed that peritonitis had occurred in nearly all. Generally this was circumscribed, but in a few it extended over the whole peritoneum, and in one the adhesions were so extensive that the whole of the intestines were adherent in one solid mass, and were so removed. Notwithstanding the recent deformity that followed the closure of intestinal wounds, permanent coarctation was rarely observed, and then only in a slight degree.

SYMPTOMS, DIAGNOSIS AND PROGNOSIS.

As for the symptoms, they may be conveniently divided into the primary, or those referable to the injury itself, and the secondary, or those referable to the complications consecutive to the injury. The symptoms of the first class can be mentioned as those relative to the constitution at large and those of a local nature.

The constitutional symptoms here are the well known symptoms of shock, the same as the symptoms of severe injuries elsewhere. Although shock, in a more or less degree, is a common attendant upon these injuries, its absence, even in severe cases, is not infrequent, and it has been noted that in many cases there exists a marked disproportion between the injury and the shock. Even when attended with severe hæmorrhage, there may be a comparative absence of the symptoms relative to the same, an example of which occurred under the observation of the writer during a service as interne at the Louisville City Hospital.

An athletic negro, of apparently 20 years, was found reclining upon a porch, talking to his friends in a very rational manner, with little or no evidence of severe injury. Subsequently upon arrival at the hospital it was found that a ball of a .32 calibre had entered the left hypochondriac region, passing downward, backward and inward, lodging itself against the body of a lumbar vertebra, and in its transit half severing the descending colon and a lumbar artery near its origin, completely filling the cavity with blood. Notwitstanding an operation upon entrance by the visiting surgeon, the man sank 12 hours thereafter from hæmorrhage.

Prominent among the local symptoms are vomiting, pain, abdominal distension, with or without loss of the area of hepatic dulness, the escape of blood, bile or fæces from the external wound, and in wounds of the kidney or bladder, bloody urine. The vomit may or may not contain blood, and if the latter, it generally indicates a perforation of the stomach, but the same may also result from a non-penetrating wound of this organ. The pain is variable, and often severe, and localized in character. Abdominal distension with loss of the area of hepatic dulness indicates the escape of gases into the peritoneal cavity. Tympanitis without such indicates an accumulation within the intestinal cavity, and may occur in the absence of a lesion. When unmistakable escape of bile or fæces occurs externally, it is a positive proof of a wound of the liver or intestines. With the exception of a few drops, hæmorrhage from the external wound seldom occurs. Bloody stools, or hæmorrhage within the rectum, may also occur in perforations as well as partial divisions and contusions of the intestines, and when its occurrence is rapid it points to injury of the large intestines.

Unless the case be one that tends to an uneventful recovery, the secondary symptoms worthy of note are generally those of peritonitis, septicæmia, or pyæmia, the symptoms of which are already too common to require repetition here. Occasionally, however, an intoxication is met with to which Vechére has given the name of intestino-peritoneal septicæmia, and for a review of the latter I refer to the article by Stimson[1] on the same subject. The author's language of the review is borrowed here at length.

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[1] New York Medical Journal, 1889. Vol. II.

"This intoxication, which has variously been termed peritonism, latent peritonitis, or the asthenic form of acute peritonitis, is supposed to have its origin in an infection of the peritoneal cavity by intestinal gases or microbes that have escaped, either through an opening or by transudation through the unbroken intestinal wall, and by this is set up a fermentation which produces ptomaines whose absorption is the immediate cause of the poisoning. The autopsy reveals but slight redness of the peritoneum, or possibly one or more points of distinct inflammation, and sometimes a brown fœtid effusion. The intestines are distended and decomposition advances rapidly. The clinical features are a prompt and marked meteorism, painlessness of the abdomen, both spontaneous and on pressure, except for that which is due to the wound of the parietes when present; a normal, subnormal or but slightly elevated temperature until shortly before death, when it rises rapidly; a small rapid pulse, anorexia, thirst, nausea and even vomiting of a fæcal like matter, and a marked alteration of expression. Its course may be marked during the first three or four days only by constipation, anorexia and meteorism. Then the severe symptoms and death follow in from five to twelve days from the beginning."

Owing to the uncertainty which surrounds the symptoms it is plainly evident that a correct diagnosis of the exact nature and extent of the injury is impossible. In those cases attended with hæmatemesis, bloody urine or the indubitable escape of bile or fæces from the external wound it is safe to infer that the ball has entered the cavity and with more or less injury to the organs to which the symptoms point. However, the first two only occur in injuries of the corresponding viscera and their absence is no positive sign of the escape of these organs, and, as to the escape of bile or feces from the external wound, unless such is very large, this rarely occurs.

In view of this uncertainty, Dr. Senn has devised a so-called "Infallible Test," for the diagnosis of an injury of the gastro-intestinal canal and as a guide to the surgeon in determining his course in these cases.

The test in question is already too well known to require more than a passing introduction here, and consisting, as it does, of a rectal insufflation of hydrogen with its escape and ignition at the external wound. Besides the functions of diagnosing a gastro-intestinal perforation, it is also used at the completion of the operation to determine whether or not the gastro-intestinal canal is again intact.

The test is yet of a comparatively recent origin and since the recorded cases of its use are but few, its precise merits, or demerits, are yet unknown. So far the following objections have already been urged against it. First, that it is unreliable. Second, in the absence of gastro-intestinal injury there may be serious damage elsewhere which the test does not indicate. Third, that it may be the source of infection. Fourth, by the distension of the abdominal cavity it materially increases the danger of the anæsthesia. As for the first objection, the case of Dr. Dalton[1] clearly proves that the test is not infallible and the records abound in a number of cases where the damage was confined to the mesentery or some of the solid viscera, producing a condition beyond the reach of the test.

Dr. Senn has remarked that the gas is innocuous and does not tend to increase extravasation, but this is questionable. It does seem that where the perforated large intestine, especially the cæcum, is well filled with liquid or semi-solid fæces that extravasation would almost inevitably follow the use of the gas, since the ileo-cæcal valve offers a certain amount of resistance before it gives away, which pressure it appears would be sufficient to drive out some of the contents. This exact condition was met with in experiment 17, and, although the apparatus was not at hand for its trial, it was interesting to note the amount and ease with which extravasation occured. Moreover, some have even objected on the ground that the gas when it enters the peritoneal cavity is hardly aseptic after passing through many feet of intestines, although in the event of a perforation the insufflation is followed by an immediate laparotomy, which would allow but a momentary residence of the gas in the peritoneal cavity. That the abdominal distension with its corresponding pressure upon the diaphragm materially increases the danger of the anæsthesia is also proven in the case reported by Dr. Dalton. The test was experimentally employed here six times; in five, hydrogen was used and in the sixth it was replaced by air. In three of the five it was a success, noting in one the absence of any perforation, while in the other two it escaped and burned in a jet.

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[1] Western Medical Reporter, October, 1889. P. 218.

The remaining two could not be insufflated, owing to a perfect occlusion of the intestinal lumen with fæcal matter. Several attempts were made to overcome the obstruction with different tubes and rectal plugs, but without success, and it became evident that nothing short of its removal would suffice. The one in which there was an absence of a gastro-intestinal perforation, was corroborated by an abdominal section, and when the search was finished it became somewhat troublesome to reduce the distended intestines.

The danger of an explosion, as well as poisoning from arseniuretted hydrogen, have also been hinted, but these cannot be fairly urged against it, since, of the first sufficient evidence is at hand to allay any fears in this direction and if the reagents are chemically pure, as recommended, the second is impossible. But further on more can be seen upon this subject.

Reflection bespeaks a serious condition even in the most favorable cases, and, naturally, the prognosis increases in gravity with the extent of the injury. Although there is recorded a successful case[1] in which laparotomy was not undertaken until the fifth day, the importance of an early operation cannot be too strongly urged.

Procrastination in these injuries is usually repaid with a liberal share of harmful consequences.

Death very soon after the injury is generally either from hæmorrhage or shock and not infrequently the latter is very much dependent upon the hæmorrhage. When death occurs later it may be due to peritonitis or more generally from some of the septic processes already named.

TREATMENT.

The treatment divides itself into three indications. First, to

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[1] Klin. Zeit. und Streifragen, bd. ii., heft. 10., s. 355.